Exhibit to Agenda Item # 1.a.

Informational presentation of SMUD’s efforts, and related strategy to support solar energy over time, and into the future.

Board Finance & Audit Committee and Special SMUD Board of Directors Meeting Meeting
Tuesday, September 15, 2020, scheduled to begin at 5:30 p.m.
Virtual Meeting (online)
Agenda

• History of Support for Solar at SMUD
• SMUD’s Strategic Approach to Leading Solar Market Transformation
• Key Program highlights
• Education and low-income Solar Programs
• Where programs are headed
• Solar growth at SMUD
• Utility and rooftop solar considerations
• Solar reliability in adverse conditions
• Sustainable solar siting
SMUD’s Solar History

1984
Solar @ Rancho Seco
First POU utility scale solar system capable of powering 200 homes

1993
PV Pioneers 1
Utility-owned solar for existing residential customers

1999
PV Pioneers 2
Customer-owned solar for existing residential customers

2001
SMUD Solar Advantage Home
Solar for new residential construction

2005
SolarSmart Program
All-solar community program for new residential construction

2007-2017
SB1 Solar Incentive Program
Incentivizing, streamlining residential and commercial solar

2009
Renewable Feed in Tariff Program
Increasing SMUD’s renewable energy purchases

2015
Solar Education & Campaign
Helping customers make informed energy decisions

2017
Commercial SolarShares
Providing clean, reliable solar energy to commercial customers

Market Transformation

Market Growth

September 15, 2020 3 Board Finance & Audit Committee and Special SMUD Board of Directors Meeting
SMUD’s Strategic Approach to Leading Solar Market Transformation & Customer Adoption

<table>
<thead>
<tr>
<th>Goal: Demonstrate technologies, assess risks, market barriers</th>
<th>Goal: Market development and support</th>
<th>Goal: Mature market, customer driven adoption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market conditions: Technology cost and risk very high</td>
<td>Market conditions: Technology cost and risk moderate</td>
<td>Market conditions Technology cost and risk low</td>
</tr>
<tr>
<td>Approach: Utility-owned, variety of installation types, technologies</td>
<td>Approach: 10y buydown schedule, education, streamlining</td>
<td>Approach: Investment in cost-effective technologies, reduce subsidies</td>
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* Note: 1 MW of Solar can power 1,000 homes while sun is shining, produces energy for 200-300 homes over a year.
Bringing Solar to Sacramentans

PV Pioneer Program
1991 - 2006
Sited hundreds of utility-owned PV systems on customer rooftops to demo technology.

SB 1 Program
2007 - 2017
$130 million in incentives to put solar on over 15,000 customers’ rooftops.

Mature Market Conditions
2018 - beyond
Balance incentives and non-solar customer rates & focus on integration with storage to increase value.
Bringing Solar to New Construction

**Solar Advantage & 1st ZNE Communities**
1998 - 2005

Early testing of roof-integrated solar to prove-out technology, demonstrate Zero Net Energy.

**SolarSmart Program**
2007 - 2017

Over 4,000 high efficiency solar homes with 14 builders.

**Title 24 Solar Mandate**
2019

Requiring onsite or community solar power for all new low-rise residential homes in California.
## SMUD’s SolarShares®

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
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<tbody>
<tr>
<td>Solar Rancho Seco 1984</td>
<td><strong>1st</strong> POU utility-scale solar system in the nation capable of powering full needs of 200 homes.</td>
</tr>
<tr>
<td>Community Solar 2007</td>
<td><strong>1st</strong> offering in the nation for customers unable to purchase solar power. Subscribed in 6 months, but too expensive to scale.</td>
</tr>
<tr>
<td>Commercial Program Expansion 2017</td>
<td>Added utility-scale solar to supply 29 more commercial customers, including Golden 1 Center. Subscribed within 1 year.</td>
</tr>
<tr>
<td>Neighborhood SolarShares 2020</td>
<td>Local, community solar option for developers &amp; customers to meet Title 24 solar mandate.</td>
</tr>
</tbody>
</table>
Education and Low-Income Programs
Educating Our Community About Solar Energy

Educators

1,100 teachers trained to explore solar energy and bring STEM education into local classrooms

Customers

3,000 residents participated in solar workshops

Youth

6,500 students completed solar coursework and events
Smud.org/SolarAnswers

Thinking about going solar?

Smud.org/SolarAnswers

Solar Estimator Features

- Uses rooftop information via satellite imaging and annual electricity usage to size PV system
- Provides financial results including costs, credits, incentives, monthly expenses, lifetime savings and breakeven year for PV investment
- Tips, information, and links on researching and hiring solar installation contractors

Is solar right for me?
The Solar System Estimator is an online tool that you can use to help determine the benefits of installing a rooftop solar system on your home.

Use the tool to find your solar savings potential based on your rooftop characteristics, your electricity use, SMUD electricity rates and available tax credits and rebates.

Get an estimate

September 15, 2020 Board Finance & Audit Committee and Special SMUD Board of Directors Meeting
Solar Adoption in Sacramento: Equity Considerations

Solar Adoption Inside & Outside Disadvantaged Communities

Source: Elena Krieger, PhD, Physicians, Scientists, and Engineers for Healthy Energy
Comparison:
Solar vs. Low-Income (EAPR) Customers

<table>
<thead>
<tr>
<th>Solar Customers</th>
<th>Low-Income (EAPR) Customers</th>
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</thead>
<tbody>
<tr>
<td>Customers</td>
<td>28,000</td>
</tr>
<tr>
<td>Average Annual Income</td>
<td>$100,000</td>
</tr>
<tr>
<td>Average Square Footage</td>
<td>2,000</td>
</tr>
<tr>
<td>Home Ownership</td>
<td>91%</td>
</tr>
</tbody>
</table>

44% multi-family
56% single family
Our Low-Income Solar Programs

Solar for nonprofits

16 installs to support lower energy bills for local nonprofits.

Solar for residential customers: Grid Alternatives partnership

180 installs through partnership since mid-2016.

Solar for residential customers: Habitat for Humanity partnership

50 homes already have, or will have solar by the end of 2020.
Ready for the Future

- Integrating solar with storage
  - Incentives for energy storage
  - Smart Energy Optimizer Program
- Aligning storage & grid location needs
  - StorageShares
- Integrating solar and other distributed resources on our grid
  - Distributed Energy Resource Management System (DERMS) and Virtual Power Plant development to provide grid services
- Expanding SolarShares & Greenergy
  - Making carbon-free energy available those who can’t install it themselves
- Accurate and equitable pricing
  - NEM 2.0
Solar - Technical Considerations
Solar Benefits and the Low Carbon Future

• Utility PV Today: 170 MW (powering ~51k homes)
  • 2040: 1,800 MW total (powering ~540k homes)

• Rooftop PV Today: 215 MW (powering ~41k homes)
  • 2040: 600 MW total (powering ~114k homes)

• Generation benefits
  • Carbon free and abundant
  • Daytime generation
  • Low-cost
  • Key piece of a balanced and diversified portfolio

• New Opportunities Co-locating w/Batteries
  • Time-shifted energy at peak
  • Stable and reliable energy on most average system days
Solar Considerations: Rooftop Solar Meeting Customer Needs

- In the summer, PV + Batteries can supply a large share of customer needs
- Customers must rely on the grid for balancing

- On a cloudy day, solar is very limited and customers will rely on the grid for their needs
- Geographic and technology diversification is key to filling in the gaps

Summer Customer Load Example

- PV & Battery: 79%
- Grid: 21%
- Excess: 6%

Non-Summer Customer Load Example

- Grid: 82%
- PV & Battery: 18%
Solar Considerations: Solar Can Fluctuate

- SMUD’s solar projects can fluctuate up to 50% in a couple of hours.
- On a cloudy day, SMUD can only count on 10% to 70% of what we would get on a sunny day.
  - Even with a battery, we can only count on 50%
- SMUD must rely on other resources when the sun is blocked by:
  - Clouds and storms
  - Fog and smoke
- SMUD must have other resources available when solar is not generating
  - Short duration batteries can help, but don’t solve the problem

Based on actual April solar data from SMUD’s 100 MW feed-in-tariff projects
Solar Considerations: Sustained Low Solar Generation

• Bad weather can adversely affect solar output for a week or longer
• We need diverse resources that generate when solar isn't
  • Need long-duration resources, not short-duration

Only 15% of solar output is available

Based on actual historical 9-day weather in December
Multi-day (3+ days) low solar output is a regular occurrence (8 occurrences between 2017 and 2019, with over 30 days falling in these low-solar occurrences)
Solar Considerations: Solar with Batteries

• Solar with batteries helps:
  • Shift generation to maximize value
  • Quickly ramp up or down
  • Provide reserve energy or capacity for emergency or critical use
  • Provide dispatchable load

• Solar with batteries are limited by:
  • Today’s batteries last 4-6 hours at maximum discharge
  • Solar is not always available to charge batteries
  • Longer duration storage (days to weeks) or dispatchable assets are needed for reliability
## Solar Considerations: Rooftop versus Utility Scale

<table>
<thead>
<tr>
<th></th>
<th>Utility Scale Solar</th>
<th>Residential Rooftop Solar</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy Production</strong></td>
<td>50 MW powers ~15,000 homes</td>
<td>50 MW powers ~9,500 homes</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>$1/watt</td>
<td>$3/watt*</td>
</tr>
<tr>
<td><strong>System Considerations</strong></td>
<td>Easily seen and controlled for maximum operational benefit</td>
<td>Lack of visibility and limited control by system operators</td>
</tr>
<tr>
<td></td>
<td>Site/orientation can be selected to maximize system benefits and to minimize land impacts</td>
<td>Site and orientation are determined by the roof which may not be oriented for maximum benefit</td>
</tr>
</tbody>
</table>

*LBNL: [https://emp.lbl.gov/sites/default/files/tracking_the_sun_2019_report.pdf](https://emp.lbl.gov/sites/default/files/tracking_the_sun_2019_report.pdf)
SMUD Goals for Sustainable Utility Scale Solar Siting

• Prioritize solar on industrial or previously disturbed land:
  • Mechanically disturbed land
  • Brownfields, superfund sites, and contaminated lands, per EPA Repowering America guidelines
    • Rancho Seco I was built on decommissioned nuclear site

• Avoid impacts to sensitive environmental areas to the maximum extent possible (endangered species, wetlands, and cultural lands)
  • Utilize fixed tilt system at Rancho Seco to minimize impact

• Look for opportunities for mutually beneficial use of solar developed land (pollinator habitat, grazing, and land-based carbon sequestration)
  • New solar will allow for grazing and pollinator planting post construction

• Prioritize projects that use local workforce and materials to the extent possible; wages are at or above prevailing rates
Near-term Solar and Battery Storage Development

- Utility PV in-operation:
  - Locally, 110 MW of solar
  - Regionally, 60 MW of solar
  - Powering ~51k homes

- Utility PV under-development:
  - Locally, 425 MW solar with 100 MW of battery
  - Regionally, 100 MW of solar
  - Powering ~160k homes

- Rooftop Solar: 215 MW installed to date (powering ~41k homes)
Longer Duration Storage: Hydrogen Flow Batteries

Power to Gas Technology: Hydrogen Renewable Gas

Carbon Sequestration: Land-Based & Geologic

Future Opportunities

Customer Demand Programs

Carbon Offset Programs
Questions?